

TOUCH DETECTION FOR A DIGITIZER

RELATIONSHIP TO EXISTING APPLICATIONS

[0001] The present application claims priority from U.S. Provisional Application No. 60/446,808, filed Feb. 10, 2003, and U.S. Provisional Application No. 60/501,484 filed Sep. 5, 2003, the contents of which are hereby incorporated by reference.

FIELD AND BACKGROUND OF THE INVENTION

[0002] The present invention relates to a combined touch and stylus digitizer and, more particularly, but not exclusively to adaptations for the detection of finger touch.

[0003] The popularity of computers has given rise to extensive research and development in the field of digitizers and touch screens. There are many inventions describing touch panels but very few describe a digitizer capable of detecting both an EM stylus and finger touch using the same sensing device. U.S. patent application Ser. No. 09/629,334 "Physical Object Location Apparatus and Method and a Platform using the same" filed Jul. 7th 2000 assigned to N-trig Ltd and U.S. patent application Ser. No. 09/628,334 "Transparent Digitizer" filed Aug. 28, 2003 also assigned to N-trig Ltd describe positioning devices capable of detecting multiple physical objects, preferably styluses, located on a flat screen display.

[0004] U.S. patent application Ser. No. 10/270,373 "Dual Function Input Device And Method" filed Oct. 15, 2002 and assigned to N-trig Ltd, describes a system capable of detecting electro magnetic objects and finger touch using the same transparent sensor. In the disclosure, the finger touch detection is implemented by a matrix of resistive stripes that are merged into the EM detection pattern. A special separation layer is placed between the conductor layers so as simultaneously to enable touch stripe contact and prevent contact between the EM lines. Additional electronics are required to drive and read the touch signals from the sensor. The major disadvantage of this method is the additional complexity to both sensor and electronics.

[0005] U.S. Pat. No. 3,944,740 employs an input pad mounted over the top of a plasma panel display. The input pad is a matrix of conductive rows and columns that are arranged so that a stylus having a conductive tip can short circuit a row electrode and a column electrode at its point of contact, with current conducted through the row and column electrodes representing the stylus location. U.S. Pat. No. 4,639,720 employs a similar idea using conductive pixels rather than a matrix of rows and columns.

[0006] Two major disadvantages of the above patents are low resolution of the stylus detection and inability to specifically detect an electromagnetic type stylus. Since the stylus is detected only when it shortcuts two adjutant lines/pixels it is impossible to track it when it is located between the lines/pixels. Therefore the resolution of the stylus detection is limited to the proximity of the lines/pixels. The stylus detection, as disclosed in these patents, is inherently different from the one described in the presently preferred embodiments. U.S. Pat. No. 6,239,389 describes a method of finger detection by measuring a first set of voltage values from each conductive line, and calcu-

lating a weighted average of these samples with respect to samples made without the presence of a finger. The sensor is constructed from a series of plates arranged in rows and columns and connected by a conductive line. The main disadvantages of this method are that it requires an arithmetic unit for calculating the weighted average of the sampled values, it does not allow the detection of an EM stylus and the sensor is not transparent.

[0007] U.S. Pat. No. 4,550,221 describes a sensor array comprising of series of conductive plates/pixels connected by a conductive wire. A finger touch changes the pixel's capacitance with respect to ambient ground. The change is detected and translated to indicate a finger's position. The disclosure does not allow the detection of an EM stylus together with finger detection. The sensor's plates/pixels are not transparent and therefore cannot be mounted on a display screen.

[0008] U.S. Pat. No. 4,293,734 employs two current sources driving predetermined currents through each end of the antenna. The finger's position is calculated using Kirchhoff's laws for current leakage through the finger to the ground. Disadvantages of the detection system disclosed therein are that it does not allow the detection of an EM stylus. Rather it requires current flows from both ends of the conductive surface which is in evidently power consuming. Furthermore, the detection is analog and involves relatively complicated circuitry.

[0009] U.S. Pat. No. 6,452,514 employs two or more electrodes arranged to create an electric field transmitted through an adjacent dielectric, which can be disturbed by the proximity of a conductive object. A charge transfer measurement circuit is connected to one of the electrodes to determine the existence of the object. The disclosure teaches connecting each electrode to an individual charge transfer measurement unit. Disadvantages of the above invention are the inability to detect an EM stylus, low update rate and limited resolution.

[0010] U.S. Pat. No. 6,583,676 describes a method of detecting a finger's added capacitance upon application of a frequency change. A calibration circuit and method for a proximity/touch detector allow automatic calibration to the proximity/touch detector components, chassis affects, and ambient conditions such that initial factory calibration and periodic manual calibration are not needed. The calibration circuit switches a capacitance into the input capacitance of a Schmitt trigger free running oscillator to change the output frequency of the oscillator. A capacitive sensor forms part of the input capacitance. The change in frequency simulates the frequency shift associated with the difference in input capacitance generated when an object, such as a finger, is touching the capacitive sensor and when the capacitive sensor is free from contact with the object. The most evident disadvantages of this invention is the need for additional hardware and the inability to detect an EM stylus.

[0011] Other methods of finger detection can be found in U.S. Pat. Nos. 6,587,093, 6,633,280, 6,473,069, and 6,278,443. The above describe methods of finger detection all inherently different from the methods described hereinbelow, and none combine the ability to sense both an EM stylus and a finger touch.

[0012] There is thus a widely recognized need for, and it would be highly advantageous to have, a digitizer system devoid of the above limitations.